MONTHLY WEATHER REVIEW.

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INTRODUCTION.

This REVIEW contains a general summary of the meteorological conditions which prevailed over the United States and Canada during July, 1886, based upon the reports from the regular and voluntary observers of the Signal Service and from co-operating state weather services.

Descriptions of the storms which occurred over the north Atlantic Ocean during the month are also given, and their approximate paths shown on chart i. In tracing the centres of the paths of these storms, data from the reports of one hundred and eighty-seven vessels have been used.

On chart i for this month are traced the paths of thirteen areas of low pressure; the average number for July during the last thirteen years being 9.0. The areas described as numbers v and xiii exhibited considerable energy in their passage over New England and the middle Atlantic states.

Chart number vii in this REVIEW shows the atmospheric conditions reported immediately preceding the occurrence of destructive tornadoes in Ohio during the night of the 13th.

Chart viii shows the atmospheric conditions attending the occurrence of thunder-storms on the 14th.

Icebergs were numerous during the month on the Banks of Newfoundland and in the trans-Atlantic track, through, and to the eastward of, the Strait of Belle Isle; many of them being of great size.

The mean atmospheric pressure for the month is generally below the normal, but the departures are small.

East of the Mississippi River the month has been colder than the average July. In the western half of the country the temperature is considerably in excess of the normal.

The most striking feature in connection with the meteorology of the month is the large deficiency of rainfall in all the central districts, producing in some states disastrous droughts, while along the coast of the south Atlantic states, especially in North Carolina and Florida, the monthly rainfall was unusually large, 21.12 inches falling at Wilmington, North Carolina, and 14.97 inches at Jacksonville, Florida.

In the preparation of this REVIEW the following data, received up to August 20, 1886, have been used, viz., the regular tri-daily weather-charts, containing data of simultaneous observations taken at one hundred and thirty-three Signal Service stations and twenty Canadian stations, as telegraphed to this office; one hundred and sixty-three monthly journals; one hundred and sixty-one monthly means from the former, and twenty monthly means from the latter; two hundred and seventy-seven monthly registers from voluntary observers; sixty-five monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the publishers of "The New York Maritime Register;" monthly weather reports from the New England Meteorological Society, and from the local weather services of Alabama, Colorado, Dakota, Georgia, Indiana, Iowa, Kansas, Minnesota, Missouri, Nebraska, Ohio, and Tennessee; trustworthy newspaper extracts, and special reports.

ATMOSPHERIC PRESSURE.

[*Expressed in inches and hundredths.*]

The distribution of mean pressure for July, 1886, determined from the tri-daily telegraphic observations of the Signal Service, is shown by isobarometric lines on chart ii.

The mean atmospheric pressure for the month is greatest over the north Pacific coast region, where the average pressure is 30.00. Another area of comparative high pressure covers the south Atlantic coast, east Gulf states, and Florida, the average pressure for this section being 29.95, in Florida; at Cedar Keys and at Key West the mean pressure rises to 29.98. The area of minimum pressure covers the middle and southern plateau regions, and is enclosed by the isobar of 29.80; at one station within this area, Yuma, Arizona, the mean pressure for the month is only 29.73. Another area of low pressure is shown by the isobar of 29.85, and extends over northern Maine and the lower Saint Lawrence valley; one station, Father Point, Quebec, giving a monthly mean of 29.81.

The departures from the normal pressure are given in the table of miscellaneous meteorological data, and are also shown on chart iv by lines connecting stations of equal departure. The mean pressure for the month is generally below the normal, although the departures are nowhere very great, the largest deficiences occurring in the Gulf States and in Missouri and Tennessee. The largest departure within this area occurs at Vicksburg, Mississippi, where the mean pressure for the month is .11 below the normal. Along the Pacific coast the mean pressure is also below the normal, the deficiency averaging about .06, the largest departure, .08, occurring at Portland, Oregon. In Maine, the upper lake region, and in portions of the northern and middle slopes, the pressure is slightly in excess of the normal, averaging only about .01.

As compared with the mean pressure for the preceding month, June, 1886, an increase of from .01 to .05 occurs in the Gulf States, Texas, New Mexico, and Arizona. In Washington Territory, Oregon, Idaho, and Montana the mean pressure for the month is from .04 to .09 less than that of the preceding month.

BAROMETRIC RANGES.

The monthly barometric ranges at the various Signal Service stations are also given in the table of miscellaneous data. The greatest ranges occurred in Dakota, Minnesota, the Lake districts, and New England. In the southern districts the ranges were small.

The following are some of the extreme monthly ranges:

Greatest.	Inch.	Least.	Inch.
Bismarck, Dakota	0.73	Fort Davis, Texas	0.24
Fort Totten, Dakota	0.71	Fort Bidwell, California	0.24
Eastport, Maine	0.70	San Diego, California	0.26
Saint Vincent, Minnesota	0.69	Los Angeles, California	0.27
Moorhead, Minnesota	0.65	Fort Stockton, Texas	0.27
Fort Buford, Dakota	0.64	Frisco, Utah	0.27

AREAS OF HIGH PRESSURE.

[Prepared by Lieut. J. C. WALSHE, Signal Corps, U. S. Army, Assistant.]

Six areas of high pressure appeared within the limits of the United States during the month of July, 1886, with well defined direction of movement which could be charted. A noticeable feature for the month was the area of high pressure, with which the month opened, over the Lake region and New England, and which gradually extended over the entire region east of the Mississippi River, with slight fluctuations, up to the morning of the 6th, when it was augmented by an area of high pressure from the Northwest, here described as number i.

Another noticeable feature was the areas of high pressure over the north Pacific coast, which remained nearly stationary, with slight fluctuations from the 1st to the 6th, from the 8th to the 17th, 21st to the 23d, and 25th to 28th, none of which apparently crossed the Rocky Mountains, but moved north or south, or slowly dissipated by decrease of pressure. The centres of these areas of high pressure were off the coast of California and Oregon.

I.—The morning map of the 6th showed an area of high pressure moving eastward over Lake Superior, followed by a well-defined area of low pressure over the extreme northwest. This high area moved to the southeast, with increasing pressure, and on the morning of the 7th was well defined and central over northern Minnesota. It moved eastward, with slightly increased pressure, on that day, and by midnight was central over Lake Superior. At this time the area of low pressure which had preceded it was passing into the Atlantic off the coast of Nova Scotia, and another area of low pressure appeared to be developing to the west of it. On the 8th it was central over Michigan, and, moving rapidly eastward on that night, the morning map of the 9th showed the centre of high pressure a little to the north of Massachusetts, after which it disappeared eastward into the Atlantic. The movement of this area eastward was attended by clear or fair weather over the lower lake region, the middle Atlantic, and the New England states from the beginning of the month to the afternoon of the 9th.

II.—On the morning of the 10th a symmetrical and well-defined area of moderately high pressure was observed central over southern Minnesota, bounded by the isobar of 30.0. To the east of this high area an area of low pressure was moving eastward over the Saint Lawrence Valley, while to the west of it an area of low pressure was advancing down the valley of the Assinaboine. This high area, with very little fluctuation of pressure, remained nearly stationary until the afternoon of the 11th. The midnight map of that date showed the centre of high pressure over the eastern part of Lake Superior, whence it passed beyond the limits of observation, leaving an area of moderately high pressure over the coast of Oregon, where it remained nearly stationary up to the 16th.

III.—On the 13th an area of moderately high pressure appeared to the northwest of Lake Superior, with a low area central over Illinois. This high area moved slowly eastward, with a slight increase of pressure, on the 14th, and by midnight of that date, but with diminished pressure, was central over Minnesota and northwestern Michigan, after which it apparently dissipated by a gradual decrease of pressure.

IV.—This area appeared to have formed in the Saskatchewan Valley, and at the morning report of the 16th was central over northern Minnesota. It advanced eastward with a slight increase of pressure and by midnight of that date was central north of Lake Superior. It remained nearly stationary until the morning of the 18th, when it was central over Lake Michigan. It then moved slowly eastward with decreasing pressure, and by midnight of that date dissipated without definite direction of movement.

V.—This area appeared on the north Pacific coast on the afternoon of the 17th and advanced slowly, following an area of low pressure which had moved down from the Saskatchewan Valley. On the morning of the 18th it was central over Montana, and on that date, advancing eastward, became more clearly defined and central over western Dakota. It moved slowly to the southeast on the 19th, and by midnight of that date gradually dissipated.

VI.—This area was first observed over northern Minnesota on the morning of the 22d. It moved rapidly eastward during the day, with a slight increase of pressure, and at the midnight report was well defined and central over eastern Michigan, with generally clear weather east of the Mississippi River, except on the coast of the Gulf of Mexico and in the south Atlantic states. On the afternoon of the 23d it was central over Lake Erie, and the isobar of 30.0, west of the Mississippi River, extended to the Gulf of Mexico, the Atlantic seaboard, and from the New England coast to the Saint Lawrence. It moved slowly eastward, and on the afternoon of the 24th the centre of high pressure moved into the Atlantic over the middle Atlantic states, where it remained nearly stationary until the midnight of the 25th, when it disappeared.

AREAS OF LOW PRESSURE.

[Prepared by Lieut. J. C. WALSHE, Signal Corps, U. S. Army, Assistant.]

Thirteen areas of low pressure have been traced from the tri-daily weather charts of July, 1886. Two of these low areas were first observed in the Gulf of Mexico and passed northward over Florida and the south Atlantic states. Five of the low areas traced passed eastward over the Saint Lawrence Valley and disappeared into the Atlantic. One low area developed in the Rocky Mountains and passed southward to Texas. One developed in Kansas and passed northward into an extended area of low pressure extending from the Rocky Mountains to the headwaters of the Missouri River, which remained nearly stationary from the 3d to the 6th, and then disappeared with scarcely any definite movement of translation. No storm of unusual severity passed over the United States during the month of July, as the movement of translation of areas of low pressure developed but slight energy on the whole.

The following table shows the latitude and longitude in which each area of low pressure was first and last observed, with the average rate of translation in miles per hour:

Areas of low pressure.	First observed.		Last observed.		Average velocity in miles per hour.
	Lat. N.	Long. W.	Lat. N.	Long W.	
	° ′	° ′	° ′	° ′	
No. I	26 00	85.00	37 00	77 00	17.0
II					
III	44 00	98 00	39 00	89 00	20.0
IV	46 00	78 00	49 00	63 00	24.0
V	48 00	92 00	50 00	67 00	18.0
VI	52 00	114 00	35 00	99 00	21.0
VII	28 00	88 00	34 00	79 00	15.0
VIII	53 00	63 00	47 00	00 00	13.0
IX	34 00	94 00	34 00	90 00	15.0
X	49 00	91 00	49 00	62 00	29.0
XI	52 00	109 00	49 00	68 00	20.0
XII	43 00	79 00	46 00	65 00	22.0
XIII	53 00	104 00	50 00	62 00	35.0

Average hourly velocity, 19.2 miles.

I.—On the morning of June 30th this area (described in the REVIEW for June as number xi) was central south of the east Gulf states and by midnight of that date moved up over western Florida, and moving rapidly during the night was central a little to the south of Augusta, Georgia, on the morning of July 1st. During the 1st it moved northward into North Carolina. On the morning of the 2d it was central near Norfolk, Virginia, and on that date disappeared off the coast near Chincoteague, Virginia. The passage of this area over the south Atlantic states was attended by heavy rains and high southerly winds during the 1st and 2d.

The following notes by Signal Service observers are of interest:

Augusta, Georgia: on the morning of the 1st rain fell until 10.40 a. m., accompanied from 1.30 a. m. until 6.15 a. m. by a strong northeasterly wind, which at 4.38 a. m. attained the force of a gale of thirty miles per hour.

Kitty Hawk, North Carolina: during the 1st light rain and easterly wind

prevailed; at 3.50 p. m. the wind had increased to a gale of forty-two miles per hour.

Fort Macon, North Carolina: a violent wind and rain storm, attended by thunder and lightning, prevailed during the 1st. The rainfall was very heavy, 6.49 inches falling in twenty-four hours. The wind veered from northeast to southeast, from which point it blew a gale of forty-four miles per hour at 11.30 a. m.

II.—On the afternoon of the 2d an area of low pressure extended over the Rocky Mountain region, having three minor depressions, one in Colorado, one in Utah, and one in Dakota. The morning map of the 3d showed an extensive area of low pressure over the entire Rocky Mountain region, with the lowest pressure near Salt Lake City, Utah. Without any well-defined movement this area remained over the Rocky Mountain region, moving slowly northward and then eastward on the morning of the 5th, after which it disappeared by a gradual increase of pressure. The midnight map of the 3d showed heavy rains in Minnesota and northern Dakota, due to the trough of low pressure extending elliptically from Salt Lake City, Utah, to northern Dakota.

III.—The midnight map of the 8th showed a small area of low pressure central over southern Dakota, with an area of moderately high pressure extending from the upper Mississippi river to the New England coast. The movement of this low area was to the eastward, attended during the 9th by light rains in Iowa, northern Illinois, and Michigan. It turned southward during the night of that date and dissipated by a gradual increase of pressure, leaving two secondary areas of low pressure—one central over Pennsylvania and New Jersey and another central over the Saint Lawrence Valley. These secondary areas were attended with light rains in the Ohio Valley, western Pennsylvania, western New York, and the New England states on the 10th.

IV.—This area, previously referred to as a secondary area in the description of number iii, apparently developed over the Province of Ontario on the afternoon of the 10th, and, attended with light rains in the New England states and Saint Lawrence Valley, moved in a northeasterly direction over the Saint Lawrence Valley, producing light rains in the Maritime Provinces. It developed little energy, however, and passed into the Gulf of Saint Lawrence on the afternoon of the 11th.

V.—During the 12th an area of low pressure extended over Manitoba, and on the night of that date developed into a well-defined area central near Duluth, Minnesota. It moved slowly to the east, developing little energy, but attended with light rains. It turned southward and was central in eastern Iowa on the afternoon of the 13th. It then moved rapidly eastward, attended by light rains in the eastern quadrant, and moved slowly over the lower lake region. After curving to the south over Pennsylvania on the 14th it again turned northward and moved slowly over the Saint Lawrence Valley and disappeared over the Gulf on the 17th. The passage of this low area was attended with rains in the lower lake region, western New York, and the New England states from the 14th to the 17th.

The following notes relative to this storm have been received:

Port Huron, Michigan: a thunder-storm, with heavy rain, began at 4.25 p. m. and ended at 10.50 p. m. of the 13th. At 4.51 p. m. a gale of twenty-eight miles per hour from the southeast set in, and continued until 5.06 p. m.

Milwaukee, Wisconsin: at 10.37 a. m. of the 14th a northerly gale set in and continued until 10.53 a. m. The wind attained a maximum velocity of thirty-two miles per hour at 10.45 a. m.

Chicago, Illinois: the storm which occurred here early in the morning of the 14th was very severe on the lake.

Jacksonville, Athens county, Ohio: shortly after 2 a. m. of the 14th a heavy storm of wind and rain passed over this place, unroofing houses and uprooting trees. Farming interests suffered severely, many acres of corn and oats being nearly destroyed by hail.

Chautauqua, New York: on the night of the 13–14th a severe gale, accompanied by rain and hail, occurred at this place. A large pavillion was damaged and a number of cottages unroofed. At Randolph the damage to crops and buildings amounted to many thousands of dollars. Hail-stones as large as hen's eggs covered the ground and destroyed much wheat.

Wheeling, West Virginia: a storm of rain, wind, and hail passed over this city and vicinity about 6 a. m. of the 14th. A number of houses were unroofed and trees blown down in this place. Reports from the surrounding country show that this storm was quite disastrous to farming interests; orchards being blown down and grain destroyed by hail. Near Gould's Station, in Ohio, a tornado occurred which cut a path one hundred yards wide through a heavy belt of timber, but otherwise did no damage.

Corry, Erie county, Pennsylvania: a very heavy thunder-storm and gale occurred here on the night of the 13–14th and destroyed considerable property; dwelling houses and barns were struck and burned by lightning, and a number of cattle killed. Hail-stones, as large as butternuts, fell, covering the ground and damaging crops.

Pittsburg, Pennsylvania: reports from numerous places in western Pennsylvania and eastern Ohio show that an extensive and damaging storm prevailed over those sections on the morning of the 14th. In Alleghany and this city the wind blew a gale and some slight damage was done, but in the surrounding country the injury to crops and buildings was considerable. In quite a number of places the storm was accompanied by lightning which was unusually destructive; numerous buildings were struck and ignited both in this state and Ohio. In Holmes county, Ohio, the wind was very heavy and destructive, orchards and fields of corn and oats were leveled to the ground. In some places the storm was attended by heavy and destructive hail.

Newark, New Jersey: on the night of the 14–15th a heavy rain and windstorm occurred at this place and over Essex county. The rainfall was very heavy and hundreds of cellars in the lower part of the city were flooded on account of the unusually high tide in the Passaic River. A large sewer along the track of the Pennsylvania Railroad caved in during the night, undermining the railroad and causing a suspension of traffic. Reports from various parts of Essex county state that the storm was severe and that crops were flooded and buildings destroyed by lightning.

By reference to the matter under the headings of "Hail" and "Local storms and tornadoes" in this REVIEW, it will be seen that the most severe local storms of the month occurred during the prevalence of this area of low pressure.

VI.—The midnight report of the 16th indicated that an area of low pressure was developing in the Saskatchewan Valley, and the morning map of the 17th showed it more clearly defined. It moved slowly eastward on that date, being retarded by an area of high pressure central over Lake Superior. South of this low area an extensive depression covered the central and southern Rocky Mountain region, while an area of high pressure appeared to follow from the Saskatchewan Valley. On the afternoon of the 18th the centre of this depression was over northern Nebraska, while the area of high pressure previously referred to moved to the south of Lake Superior. The relative positions were maintained during the night of the 18th, when the centre of disturbance was in southern Kansas, and after the morning observation of the 19th it dissipated by a gradual increase of pressure, apparently without passing into the Gulf of Mexico, where a storm was then developing somewhat to the east of Cedar Keys, Florida.

VII.—The development of this area was first observed on the morning of the 18th in the Gulf of Mexico, and approximately located as having the centre of disturbance about one hundred and fifty miles south of Pensacola, Florida. It moved eastward slowly on that date and the morning map of the 19th showed it central over Jacksonville, Florida. Brisk to high southerly winds prevailed at Key West on the 18th and 19th, with light rains extending from Key West to South Carolina. It moved slowly along the coast, attended with light rains, but apparently decreasing in energy after leaving the Gulf, and disappeared into the Atlantic off the coast of Virginia on the 20th.

The following extracts, relative to this storm, have been obtained from Cuban newspapers forwarded to this office by the Rev. Benito Viñes, director of the Belen College Observatory, Havana, Cuba:

HAVANA, *July* 13, 1886.—Since the day before yesterday there have been indications of a cyclonic disturbance in the South Sea; it passed from the second to the third quadrant, and will pass us by the west. The storm has also been indicated in the higher regions by faint solar and lunar halos.

HAVANA, *July* 16, 1886.—The cyclonic disturbance which I mentioned in my last communication, after having advanced slowly by the west, has passed us by the fourth quadrant, and is probably at present advancing in a northeasterly direction, and will penetrate the United States by entering at Mobile and Key West. The slowness by which the phenomenon has been characterized, induces me to suspect that the storm has made a recurve to the west of the island, where it will remain but a very short time. To-day, copious rains have fallen in Vuelta-Abajo.

HAVANA, *July* 17, 1886.—The thunder in the southwest, west, and north-

west, which has prevailed during the day, is usually followed by a storm in the south, the influence of which commences to be felt at present in the United States, where precautionary dispatches were sent during the 13th, 15th, and 16th. Since this morning no dispatch has been received from the province of Pinar del Rio, there having been heavy thunder and squalls in the southwest and west, where the storm seems to be far more severe than at Havana.

The following dispatches were received by the Rev. Benito Viñes, during the prevalence of the storm:

Pinar del Rio, July 16th, 9 a. m.: cloudy; copious rains from 7.30 to 8.30 a. m.

Consolacion del Sur, July 16th: at 4.27, aneroid, 29.92 (760.0 mm.); thermometer, 76°.1 Fahr. (24°.5 Cent.); wind sw., in general threatening and heavy squalls from the w.

MENÉNDEZ.

Consolacion del Sur, July 16th, 8.30 a. m.: notable and rapid fall; aneroid, 29.87 (758.8 mm.); 78°.8 Fahr. (26° Cent.); very threatening; raining in the sw.; weather squally.

MENÉNDEZ.

Mantua, July 16th, 8 a. m.: aneroid barometer, —— (—— mm.); thermometer, 84°.2 Fahr. (29° Cent.); clouds low, with violent gale in the west; the sea agitated; the storm commences to be felt; wind variable from the se.

Coloma, July 17th, 8 a. m.: aneroid barometer, 30.12 (765.0 mm.); thermometer, 71°.6 Fahr. (22° Cent.); winds se., fresh; direction of the lower clouds nw.; sea smooth.

Pinar del Rio, July 17th, 8.30 a. m.: the weather continues cloudy and rainy.

Consolacion del Sur, July 17th, 8 a. m.: aneroid barometer, 29.96 (761.0 mm.); thermometer, 75°.2 Fahr. (24° Cent.); winds sw.; it rains since yesterday, without interruption, from sw. and s.; very gloomy; thunder from the sw. and s.

MENÉNDEZ.

Mantua, July 17th, 8 a. m.: since 8 o'clock yesterday morning the weather has been close, although it continues to rain at this hour; wind from e. to w., velocity, 20 metres; copious rains; horizon cloudy; barometer, —— (—— mm.); thermometer, 95°.0 Fahr. (35° Cent.); light thunder; direction steady from 10 to 15 minutes at a time. At 10 a. m. the same.

Mantua, July 18th, 8 a. m.: barometer, —— (—— mm.); thermometer, 62°.6 Fahr. (17° Cent.); horizon obscure; no wind.

Coloma, July 18th, 8 a. m.: aneroid barometer, 30.12 (765.0 mm.); thermometer, 78°.8 Fahr. (26° Cent.); wind force, 6; direction of lower clouds, n.

Pinar del Rio, 18th, 9. a. m.: at 3 a. m., surrounded by water; severe hurricane with copious rains; at this hour the weather has moderated.

Consolacion del Sur, July 18th, 8 a. m.: aneroid barometer, 29.96 (761.0 mm.); thermometer, 78°.8 Fahr. (26°.0 Cent.); wind se.; gloomy; raining from the sw.

MENÉNDEZ.

Consolacion del Sur, July 18th, 6 p. m.: barometer, 29.96 (761.0 mm.); thermometer, 78°.8 Fahr. (26°.0 Cent.); very threatening the whole day; continuous squalls w. and sw.

Bahia Honda, July 17th, 8 a. m.: wind se., slack; covered with water; aneroid barometer, 30.08 (764.0 mm.).

Bahia, Honda, July 18th, 8 a. m.: atmosphere clear; winds fresh; aneroid barometer, 30.12 (765.0 mm.).

Cienfuegas, July 18th, 8 a. m.: barometer, 30.06 (763.5 mm.); thermometer, 83° Fahr. (28°.3 Cent.); sky covered; wind fresh, s.; sea calm.

Cardenas, July 17th, 8 a. m.: wind in the south, calm; sea smooth; barometer, 30.12 (765.0 mm.); thermometer, 79° Fahr. (26°.1 Cent.); the aspect gloomy.

Cardenas, July 18th, 9.30 a. m.: weather squally; wind south, calming; sea smooth; barometer, 30.12 (765.0 mm.); thermometer, 81° Fahr. (27°.2 Cent.).

M. NEBOT.

Consolacion del Sur, July 19th, 10 a. m.: aneroid barometer, 30.12 (765.0 mm.); thermometer, 78°.8 Fahr. (26° Cent.); wind very variable from the third to the fourth quadrant; very threatening, persisting wind, sw. and s.; continuous squalls, tenaciously from the sw.; the rivers overflow.

The following dispatch was received from Batabano:

Batabano, July 17th, 10.45 a. m.: barometer has a tendency to fall; strong wind ese. and variable; heavy sea swell; gloomy; rain continues; thunder; dark.

It is to be noted that the cyclonic disturbances of June and July have all, up to the present time, passed by the south and west of the island to the fourth quadrant, attacking the United States by the Gulf States, as can be seen on the daily "weather maps," published by the Signal Service at Washington, the tracks of these storms seems to follow those of the October hurricanes.

The following is an extract from the "New York Herald" of July 19, 1886:

KEY WEST, FLORIDA, *July* 18, 1886.—The effects of the gale, which evidently passed to the westward from this place, have been severely felt during past twenty-four hours. A strong southerly wind which prevailed during the night shifted to southwest to-day, and obtained a velocity of fifty-two miles an hour, and was accompanied by spiteful rain squalls. The barometer fell during the night to 29.87. It rose this morning, but became depressed again during the afternoon. Two steamers which should have sailed this morning are still weather-bound to-night. Shipping sustained no damage.

VIII.—The development of this depression is approximated. The morning map of the 19th showed a pressure of 29.71 at Anticosti, and the afternoon map showed the depression advancing slowly southward. The midnight map of the 19th showed the centre of depression near the coast of New Brunswick, and after that date it moved slowly eastward, appearing in the Gulf of Saint Lawrence on the 20th. The isobar of 29.5 indicated the lowest pressure at any time observed during its passage, and little energy was developed inside the limits of observation. Its passage into the Gulf was attended with light rains on the coast of Nova Scotia on the 20th.

IX.—While the area just described was passing into the Gulf of Saint Lawrence an area of low pressure was developing over northern Texas, with an area of moderately high pressure over the upper Mississippi valley. The centre of depression moved northward over Arkansas, attended with light rains in the lower Mississippi valley, and then turned eastward. The midnight map of the 20th showed another low area advancing eastward over Lake Superior, and in front of these two areas of low pressure an area of moderately heavy rainfall over Indiana, Ohio, and Kentucky. The morning map of the 21st showed that this area turned southward over the valleys of the Cumberland and Tennessee and gradually dissipated by increase of pressure, with light rains over the east Gulf and south Atlantic states.

X.—This area was first observed on the midnight of the 20th central to the north of Lake Superior. It moved rapidly to the east on the 21st and passed up the Saint Lawrence Valley, developing little energy in its movement, though the rate of translation was rapid, but unattended with any appreciable rainfall until the afternoon of the 22d, after which it disappeared beyond the limits of observation.

XI.—The midnight map of the 22d showed a well-defined low area developing over the Saskatchewan Valley, bounded by the isobar of 29.6. An extensive area of low pressure covered the entire Rocky Mountain region to the south, while an area of high pressure was central over the Lake region. This area of low pressure moved eastward slowly; the midnight map of the 23d showed the centre of disturbance north of Saint Vincent, Minnesota, with light rains and thunder-storms in Dakota. On the 24th its movement was slowly eastward over the northern part of Lake Superior, with light rains in Minnesota and Michigan, and on the 25th it moved more rapidly over the Canadian provinces, disappearing on the 26th into the Gulf of Saint Lawrence, with heavy rains in the southwestern quadrant over the lower lakes and Saint Lawrence Valley. On that date an elliptical area of moderately low pressure extended from the coast of Texas to Lake Michigan, attended with light rains and thunder-storms in the Mississippi Valley and heavy rains and thunder-storms in Maryland and the lower lake region. Two secondary areas of low pressure were formed from this trough, one in Louisiana and one in lower Canada, both attended with heavy rains.

XII.—This area, referred to as a secondary area in the description of number xi, was first observed at the midnight observation of the 26th, central near Toronto. The morning map of the 27th showed it more clearly developed, central between Montreal and Kingston, and, as previously described, attended with moderate rainfall over western New York, Pennsylvania, and the New England states. During that date the area moved in a southeasterly direction and during the night turned northward along the coast of Maine and passed over New Brunswick into the Gulf of Saint Lawrence on the 28th.

XIII.—The midnight map of the 26th showed an area of low pressure developing over the valley of the Saskatchewan, and during the 27th it moved rapidly southward, inclining a little to the east, with an extended area of low pressure over the Rocky Mountain region and reaching eastward as far as Lake Michigan. The midnight map of that date showed the centre

of the depression to be northwest of Marquette, Michigan. A slight increase of pressure was apparent on the morning of the 28th, and the area of low was not clearly defined, but the centre had moved eastward. In the afternoon the centre of depression was near La Crosse, Wisconsin, indicating a retrograde movement, but the midnight map showed the centre of disturbance again north of Mackinaw City, Michigan, after which it moved eastward, attended by light rains and thunder-storms in east Michigan and Canada West, passing up the Saint Lawrence Valley and into the Gulf on the morning of the 30th.

Severe storms occurred in the middle Atlantic states and New England during the passage of this area over the Saint Lawrence Valley, as will be seen from the following reports:

Burlington, Vermont: on the 29th a severe thunder-storm and high wind occurred at Georgia, Milton, and other places north of this place. Hail did considerable damage to corn, oats, and other crops, besides breaking many windows. In some places the wind blew with almost hurricane force and numerous buildings were unroofed.

Albany, New York: on the 29th, between 9 p. m. and midnight, a very destructive thunder-storm passed over this city and the adjacent country. Between 10 and 11 p. m. the electrical part of the storm was most intense; flashes of lightning were almost incessant, and numerous buildings were struck and burned; the loss from barns which were burned during this storm will aggregate $15,000. The storm was accompanied by high wind which did considerable damage.

Sandy Hook, New Jersey: after a cloudy and extremely sultry day a thunder-storm was observed approaching the station from the northwest at 6:15 p. m. of the 30th. At 6.45 p. m. the storm struck this point with great force, and very heavy rain fell. The storm was accompanied by heavy hail, some of the stones being the size of walnuts, also by a heavy northwest squall, the wind blowing for about an hour at the rate of seventy-two miles per hour. After the storm had passed, thirty wrecks were reported from different points along the coast, and several persons drowned.

Hartford, Connecticut: a severe thunder-storm and southeast gale occurred during the night of the 29–30th. At Wethersfield, four miles south of this city, considerable damage was done by the high wind and hail which accompanied the storm at that place. The hail destroyed many acres of tobacco, entailing a loss of nearly $15,000. The storm was severe along Long Island Sound, where lightning struck many buildings and killed live stock.

Taunton, Massachusetts: on the 30th, between 2.50 and 3.45 a. m., a very severe thunder-storm occurred here. The thunder and lightning were continuous, there being no distinguishable interval between the flashes. Five buildings in this town, and many in adjoining towns, were struck by lightning.

Coney Island, New York: the storm that passed over Coney Island on the night of the 30th–31st is thought to have been the most violent of any that has occurred at this place during the summer for many years. The gale was accompanied by rain, hail, and heavy thunder and lightning. Numerous buildings were unroofed by the wind and windows broken by hail.

Philadelphia, Pennsylvania: at 3 a. m. on the 31st a gale and heavy thunder occurred in this city and over the surrounding country. Trees were uprooted by the gale, and signs and awnings blown down. The lightning was severe and several buildings were struck. Reports from Atlantic City and numerous other points along the New Jersey coast state that the gale was severe and the rainfall very heavy.

NORTH ATLANTIC STORMS DURING JULY, 1886.

[Pressure in inches and millimetres; wind-force by Beaufort scale.]

The paths of the depressions that have appeared over the north Atlantic Ocean during the month are determined, approximately, from international simultaneous observations furnished by captains of ocean steamships and sailing vessels; abstracts of ships' logs and other data collected by the Signal Service agencies at the ports of New York, Philadelphia, and Boston; reports received through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the proprietors of the "New York Maritime Register," and from other miscellaneous data received at this office up to August 20, 1886.

Of the twelve depressions traced during the month, seven, numbers 4, 5, 7, 8, 10, 11, 12, are continuations of areas of low pressure traced on the North American continent; number 1 is a continuation of land depression number x charted for June, 1886; numbers 2, 6, and 9 developed over mid-ocean; and number 3 first appeared over Newfoundland. Three depressions, numbers 3, 5, and 7, are traced across the ocean from coast to coast.

The following presents the characteristics of the depressions traced for the present month, as compared with those traced over the north Atlantic for July, 1885:

In July, 1885, six depressions appeared over the ocean, two of which were continuations of areas of low pressure which first appeared over the North American continent, but neither of these were traced to the European coast. The depressions were apparently of slight energy and were not accompanied by gales of marked violence. The general direction of movement of the tracks was east to northeast.

In July, 1886, the storms, as a rule, possessed considerable strength, and, while the depressions did not exhibit unusually low pressures, the barometric gradients were, in cases, sufficiently steep to cause disturbances of pronounced energy. The general direction of movement of the paths was, as in July, 1885, east to northeast, although in instances irregular courses were followed. The rate of progression of the depressions was, as a rule, unusually rapid.

The month opened with generally unsettled weather over the ocean; the barometer was high over the Azores, and areas of low pressure were located over Newfoundland and in about N. 42°, W. 43°. Following the eastward passage of these depressions the weather was generally fair over the ocean west of the fortieth meridian until the 7th, when the passage of an area of low pressure northeastward from Newfoundland caused gales and generally rough weather in the trans-Atlantic track during the next three days. On the 10th the pressure was high over the entire ocean south of the fiftieth parallel, except off the northern coast of the United States, where it continued low during the next two days. From the 10th to the 15th low pressure and generally stormy weather prevailed north of the fiftieth parallel, while over other portions of the ocean the weather was unsettled. From the 15th to 20th the region of greatest disturbance was to the eastward of the thirtieth meridian, while during the next five days storm-conditions existed over the entire ocean; fairer weather prevailing over the western portion during the 24th and 25th. On the 26th fresh gales and rain were encountered to the westward of the British Isles; during the balance of the month rain was frequent over the entire ocean, and during the 30th and 31st fresh gales prevailed over mid-ocean from N. 47° to 55°.

The following are brief descriptions of the depressions traced:

1.—This storm was a continuation of land depression number x for June, 1886, and passed northeastward over Newfoundland during the 1st, with central pressure about 29.50 (749.3); moving southeastward, off the northern coast of Newfoundland, it was central on the 2d in N. 47°, W. 50°, whence it passed northeastward to N. 50°, W. 45° by the 3d; during this date it advanced northeastward beyond the region of observation. No special reports have been received relative to this storm for the first three days of July, although vessel reports show that severe gales were experienced south of Newfoundland during June 30th.

2.—This depression first appeared on the 1st in N. 42°, W. 44°, and moved rapidly northeastward during the next two days, disappearing north of the fifty-fifth parallel during the 3d. This storm had pressure about 29.80 (756.9) on the 1st and 2d, after which it apparently commenced to fill up.

The following are reports of vessels which came within its influence: By Chief Officer Wm. Kinning, of the s. s. "Roman," Capt. D. Williams, commanding, "July 2d, in N. 45° 17′, W. 41° 38′, a fresh gale began from sw. at noon; veered to nw., then backed to w. and increased to strong gale w. at midnight, with very heavy seas, and continued backing to sw. in a. m. of July 3d, in N. 43′ 38′, W. 45° 21′; then veered to w. in p. m., and moderated at 8 p. m. July 2d, at noon, barometer 29.79 (756.7), and at noon on the 3d it read 29.84 (757.9)." By Chief Officer J. Barlow, of the s. s. "Bothnia," Capt. Thos. Dutton, commanding, "July 3d, in N. 48° 19′, W. 32° 36′, at 8 a. m., strong breeze from sw., and cloudy with heavy head seas, continuing all day; ship pitching and shipping seas forward; showers at midnight. July 4th, in N. 46° 34′, W. 38° 30′, strong breeze from w. to sw., with head seas; ship pitching and shipping considerable water forward;